SPECIFICATION

Electronic Version 1.2.8

Stylesheet Version 1.0

POLYGONAL FUEL CELL APPARATUS AND METHOD OF MAKING

Background of Invention

[0001] The present invention relates generally to the field of fuel cells and more specifically to fuel cells with polygonal cross-sections.

[0002] In a wide variety of applications, fuel cells are used to provide relatively cleaner and higher efficiency electrical power compared to fossil fuel burning electrical power plants.

[0003] Two design geometries have come to dominate the fuel cell field: the flat plate design and the circular tubular design (see, for example, Fuel Cell Handbook (Fifth Edition), Chapter 8, EG&G Services, available from National Technical Information Service, U.S. Department of Commerce, Springfield, VA.). The flat plate design has an advantage of high power density but suffers a disadvantage of being difficult to seal against gas leakage. Conversely, the circular tubular design offers the benefit of a more reliable gas seal, but at the cost of a reduced power density. An opportunity exists, therefore, to design a new fuel cell geometry which will retain the gas sealing performance of the circular tubular design while approaching the power density of the flat plate design.

Summary of Invention

[0004] The opportunity described above is addressed, in one embodiment of the present invention, by a polygonal fuel cell comprising: a cathode layer having a tubular shape; a contact layer electrically coupled to and disposed on the cathode layer to leave an uncovered cathode surface portion; an electrolyte layer disposed on the uncovered

cathode surface portion; and an anode layer electrically isolated from the contact layer and disposed on the electrolyte layer such that the polygonal fuel cell has a polygonal cross section.

Brief Description of Drawings

[0005] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

[0006] Figure 1 illustrates an isometric projection of a polygonal fuel cell in accordance with one embodiment of the present invention;

[0007] Figure 2 illustrates an end view orthographic projection of the polygonal fuel cell in accordance with a more detailed embodiment of the embodiment illustrated in Figure 1;

[0008] Figure 3 illustrates an end view orthographic projection of the polygonal fuel cell in accordance with another more detailed embodiment of the embodiment illustrated in Figure 1;

[0009] Figure 4 illustrates an end view orthographic projection of the polygonal fuel cell in accordance with still another more detailed embodiment of the embodiment illustrated in Figure 1;

[0010] Figure 5 illustrates an end view orthographic projection of a polygonal fuel cell stack in accordance with another embodiment of the present invention;

[0011] Figure 6 illustrates an end view orthographic projection of a polygonal fuel cell stack in accordance with a more detailed embodiment of the embodiment illustrated in Figure 5; and,

[0012] Figure 7 illustrates an end view orthographic projection of a polygonal fuel cell stack in accordance with another more detailed embodiment of the embodiment illustrated in Figure 5.

Detailed Description

[0013] In accordance with one embodiment of the present invention, Figure 1 illustrates an isometric projection of a polygonal fuel cell 100 comprising a cathode layer 110, a contact layer 120, and an anode layer 140. Cathode layer 110 has a tubular shape through which an oxidant gas flows in operation. Contact layer 120 is electrically coupled to cathode layer 110 to provide an external electrical contact and is disposed to leave an uncovered cathode surface portion. Electrolyte layer 130, disposed on the uncovered cathode surface portion, and anode layer 140, electrically isolated from contact layer 120 and disposed on electrolyte layer 130, complete polygonal fuel cell 100. In operation, fuel gas flows over anode layer 140.

[0014] Anode layer 140 is disposed on electrolyte layer 130 such that polygonal fuel cell 100 has a polygonal cross section. Compared to a circular tubular design, the tubular shape of cathode layer 110 provides comparable gas sealing capability, while the polygonal cross section permits denser packing into fuel cell stacks.

[0015] As used herein, "polygonal" refers to the shape of a plane geometric polygon, optionally with rounded corners. While sharp-cornered polygons provide the highest power density, practical considerations of manufacturability and strength may favor rounded corners for some applications.

[0016] In accordance with a more detailed embodiment of the embodiment illustrated in Figure 1, Figure 2 illustrates an end view orthographic projection of polygonal fuel cell 100 wherein the polygonal cross section is an equilateral hexagon. Figure 2 also illustrates a still more detailed embodiment of the embodiment illustrated in Figure 1, in which polygonal fuel cell 100 comprises two contact layers 120 disposed on adjacent polygonal faces to facilitate stacking.

[0017] In accordance with another more detailed embodiment of the embodiment illustrated in Figure 1, Figure 3 illustrates an end view orthographic projection of polygonal fuel cell 100 wherein the polygonal cross section is a square (i.e., an equilateral rectangle).

[0018] In accordance with still another more detailed embodiment of the embodiment illustrated in Figure 1, Figure 4 illustrates an end view orthographic projection of polygonal fuel cell 100 wherein the polygonal cross section is an equilateral triangle.

[0019] In accordance with another embodiment of the present invention, Figure 5 illustrates an end view orthographic projection of a portion of a polygonal fuel cell stack 200 comprising: a plurality of polygonal fuel cells 100, a cathode bus 170, an anode bus 180, and a plurality of interconnection strips 160. As described above, polygonal fuel cells 100 comprise contact layers 110 and anode layers 140 and have a polygonal cross section to facilitate dense packing. Each polygonal fuel cell 100 produces a characteristic voltage rise and is capable of sourcing current only up to a safe individual cell current limit. In order to meet overall requirements of polygonal fuel cell stack 200, therefore, polygonal fuel cells 100 are electrically coupled in parallel to satisfy a current requirement and in series to satisfy a voltage requirement. Stack voltage is made available externally by electrically coupling contact layers 110 to cathode bus 170 and by electrically coupling anode layers 140 to anode bus 180. Cell-to-cell and cell-to-bus electrical coupling is achieved by interposing interconnection strips 160 therebetween. Interconnection strips 160 also provide spacing among polygonal fuel cells 100 to permit gas flow over anode layers 140.

[0020] In a more specific embodiment, Figure 5 also shows polygonal fuel cell stack 200 wherein the polygonal cross section is an equilateral hexagon and wherein each of polygonal fuel cells 100 comprises two of contact layers 120 disposed on adjacent polygonal faces.

[0021] In accordance with a more detailed embodiment of the embodiment illustrated in Figure 5, Figure 6 illustrates an end view orthographic projection of a polygonal fuel cell stack wherein the polygonal cross section is a square (i.e., an equilateral rectangle).

[0022] In accordance with another more detailed embodiment of the embodiment illustrated in Figure 5, Figure 7 illustrates an end view orthographic projection of a polygonal fuel cell stack wherein the polygonal cross section is an equilateral triangle.

[0023] While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.